## Product Specifications

<table>
<thead>
<tr>
<th>Customer</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>2.7” E-PAPER DISPLAY</td>
</tr>
<tr>
<td>Model Name</td>
<td>2.7inch e-Paper V2</td>
</tr>
<tr>
<td>Date</td>
<td>2022/10/10</td>
</tr>
<tr>
<td>Revision</td>
<td>1.0</td>
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## REVISION HISTORY

<table>
<thead>
<tr>
<th>Rev</th>
<th>Date</th>
<th>Item</th>
<th>Page</th>
<th>Remark</th>
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<tr>
<td>1.0</td>
<td>Oct.10.2022</td>
<td>New Creation</td>
<td>ALL</td>
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</table>
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1. Over View

This display is an Active Matrix Electrophoretic Display (AM EPD), with interfaceand a reference system design. The display is capable to display image at 1-bit white,black full display capabilities. The 2.7inch active area contains 264×176pixels. Themodule is a TFT-array driving electrophoresis display, with integrated circuits including gate driver, source driver, MCU interface, timing controller, oscillator, DC-DC, SRAM, LUT, VCOM. Module can be used in portable electronic devices, such as Electronic Shelf Label (ESL) System.

2. Features

264×176 pixels display with touchscreen
High contrast High reflectance
Ultra wide viewing angle Ultra low power consumption
Pure reflective mode
Bi-stable display
Commercial temperature range
Landscape portrait modes
Hard-coat antiglare display surface
Ultra Low current deep sleep mode
On chip display RAM
Waveform can stored in On-chip OTP or written by MCU
Serial peripheral interface available
On-chip oscillator
On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
I2C signal master interface to read external temperature sensor
Built-in temperature sensor

3. Mechanical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>2.7</td>
<td>Inch</td>
<td></td>
</tr>
<tr>
<td>Display Resolution</td>
<td>264(H)×176(V)</td>
<td>Pixel</td>
<td>Dpi:117</td>
</tr>
<tr>
<td>Active Area</td>
<td>38.19×57.29</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Pixel Pitch</td>
<td>0.217×0.217</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Pixel Configuration</td>
<td>Rectangle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outline Dimension</td>
<td>45.8 (H)×70.42(V) ×1.23(D)</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>TBD</td>
<td>g</td>
<td></td>
</tr>
</tbody>
</table>
4. Mechanical Drawing of EPD module
## 5. Input /Output Pin Assignment

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>I/O</th>
<th>Description</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>O</td>
<td>Do not connect with other NC pins</td>
<td>Keep Open</td>
</tr>
<tr>
<td>2</td>
<td>GDR</td>
<td>O</td>
<td>N-Channel MOSFET Gate Drive Control</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RESE</td>
<td>I</td>
<td>Current Sense Input for the Control Loop</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>NC</td>
<td>Do not connect with other NC pins</td>
<td>Keep Open</td>
</tr>
<tr>
<td>5</td>
<td>VSH2</td>
<td>C</td>
<td>Positive Source driving voltage(Red)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>TSCL</td>
<td>O</td>
<td>I²C Interface to digital temperature sensor Clock pin</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>TSDA</td>
<td>I/O</td>
<td>I²C Interface to digital temperature sensor Data pin</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>BS1</td>
<td>I</td>
<td>Bus Interface selection pin</td>
<td>Note 5-5</td>
</tr>
<tr>
<td>9</td>
<td>BUSY</td>
<td>O</td>
<td>Busy state output pin</td>
<td>Note 5-4</td>
</tr>
<tr>
<td>10</td>
<td>RES#</td>
<td>I</td>
<td>Reset signal input. Active Low.</td>
<td>Note 5-3</td>
</tr>
<tr>
<td>11</td>
<td>D/C#</td>
<td>I</td>
<td>Data /Command control pin</td>
<td>Note 5-2</td>
</tr>
<tr>
<td>12</td>
<td>CS#</td>
<td>I</td>
<td>Chip select input pin</td>
<td>Note 5-1</td>
</tr>
<tr>
<td>13</td>
<td>SCL</td>
<td>I</td>
<td>Serial Clock pin (SPI)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>SDA</td>
<td>I</td>
<td>Serial Data pin (SPI)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>VDDIO</td>
<td>P</td>
<td>Power Supply for interface logic pins It should be connected with VCI</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>VCI</td>
<td>P</td>
<td>Power Supply for the chip</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>VSS</td>
<td>P</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>VDD</td>
<td>C</td>
<td>Core logic power pin VDD can be regulated internally from VCI. A capacitor should be connected between VDD and VSS</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>VPP</td>
<td>P</td>
<td>FOR TEST</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>VSH1</td>
<td>C</td>
<td>Positive Source driving voltage</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>VGH</td>
<td>C</td>
<td>Power Supply pin for Positive Gate driving voltage and VSH1</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>VSL</td>
<td>C</td>
<td>Negative Source driving voltage</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>VGL</td>
<td>C</td>
<td>Power Supply pin for Negative Gate driving voltage VCOM and VSL</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>VCOM</td>
<td>C</td>
<td>VCOM driving voltage</td>
<td></td>
</tr>
</tbody>
</table>
I = Input Pin, O =Output Pin, I/O = Bi-directional Pin (Input/output), P = Power Pin, C = Capacitor Pin

**Note 5-1:** This pin (CS#) is the chip select input connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW.

**Note 5-2:** This pin is (D/C#) Data/Command control pin connecting to the MCU in 4-wire SPI mode. When the pin is pulled HIGH, the data at SDA will be interpreted as data. When the pin is pulled LOW, the data at SDA will be interpreted as command.

**Note 5-3:** This pin (RES#) is reset signal input. The Reset is active low.

**Note 5-4:** This pin is Busy state output pin. When Busy is High, the operation of chip should not be interrupted, command should not be sent. The chip would put Busy pin High when –Outputting display waveform -Communicating with digital temperature sensor

**Note 5-5:** Bus interface selection pin

<table>
<thead>
<tr>
<th>BS1 State</th>
<th>MCU Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>4-lines serial peripheral interface(SPI) - 8 bits SPI</td>
</tr>
<tr>
<td>H</td>
<td>3-lines serial peripheral interface(SPI) - 9 bits SPI</td>
</tr>
</tbody>
</table>

### 6. Electrical Characteristics

#### 6.1 Absolute Maximum Rating

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic supply voltage</td>
<td>VCI</td>
<td>-0.5 to +6.0</td>
<td>V</td>
</tr>
<tr>
<td>Logic Input voltage</td>
<td>VIN</td>
<td>-0.5 to VCI +0.5</td>
<td>V</td>
</tr>
<tr>
<td>Logic Output voltage</td>
<td>VOUT</td>
<td>-0.5 to VCI +0.5</td>
<td>V</td>
</tr>
<tr>
<td>Operating Temp range</td>
<td>TOPR</td>
<td>0 to +50</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temp range</td>
<td>TSTG</td>
<td>-25 to +70</td>
<td>°C</td>
</tr>
<tr>
<td>Optimal Storage Temp</td>
<td>TSTGo</td>
<td>23±2</td>
<td>°C</td>
</tr>
<tr>
<td>Optimal Storage Humidity</td>
<td>HSTGo</td>
<td>55±10</td>
<td>%RH</td>
</tr>
</tbody>
</table>

**Note:**

Maximum ratings are those values beyond which damages to the device may occur. Functional operation should be restricted to the limits in the Panel DC Characteristics tables.

#### 6.2 Panel DC Characteristics

The following specifications apply for: VSS=0V, VCI=3.0V, TOPR =25°C.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Applicable pin</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single ground</td>
<td>$V_{SS}$</td>
<td>--</td>
<td>--</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Logic supply voltage</td>
<td>$V_{CI}$</td>
<td>VCI</td>
<td>2.2</td>
<td>3.0</td>
<td>3.7</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Core logic voltage</td>
<td>$V_{DD}$</td>
<td>VDD</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>High level input voltage</td>
<td>$V_{IH}$</td>
<td>--</td>
<td>0.8 $V_{CI}$</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Low level input voltage</td>
<td>$V_{IL}$</td>
<td>--</td>
<td>-</td>
<td>-</td>
<td>0.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>High level output voltage</td>
<td>$V_{OH}$</td>
<td>IOH = -100uA</td>
<td>--</td>
<td>0.9</td>
<td>VCI</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Low level output voltage</td>
<td>$V_{OL}$</td>
<td>IOL = 100uA</td>
<td>--</td>
<td>--</td>
<td>0.1</td>
<td>$V_{CI}$</td>
<td></td>
</tr>
<tr>
<td>Typical power</td>
<td>$P_{TYP}$</td>
<td>$V_{CI}=3.0V$</td>
<td>--</td>
<td>TBD</td>
<td>--</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Deep sleep mode</td>
<td>$P_{STPY}$</td>
<td>$V_{CI}=3.0V$</td>
<td>--</td>
<td>0.003</td>
<td>--</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Typical operating current</td>
<td>$I_{opr_V_{CI}}$</td>
<td>$V_{CI}=3.0V$</td>
<td>--</td>
<td>TBD</td>
<td>--</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Full update time</td>
<td>--</td>
<td>25 ºC</td>
<td>3</td>
<td>sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast update time</td>
<td>--</td>
<td>25 ºC</td>
<td>1.5</td>
<td>sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial update time</td>
<td>--</td>
<td>25 ºC</td>
<td>0.42</td>
<td>sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep mode current</td>
<td>$I_{slp_V_{CI}}$</td>
<td>DC/ DC off</td>
<td>--</td>
<td>-</td>
<td>-</td>
<td>20 uA</td>
<td></td>
</tr>
<tr>
<td>Deep sleep mode current</td>
<td>$I_{dslp_V_{CI}}$</td>
<td>DC/ DC off</td>
<td>--</td>
<td>-</td>
<td>-</td>
<td>1 5 uA</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1) Refresh time: the time it takes for the whole process from the screen change to the screen stabilization.
2) The difference between different refresh methods:
   Full refresh: The screen will flicker several times during the refresh process;
   Fast Refresh: The screen will flash once during the refresh process;
   Partial refresh: The screen does not flicker during the refresh process.

During the fast refresh or partial refresh of the electronic paper, it is recommended to add a full-screen refresh after 5 consecutive operations to reduce the accumulation of afterimages on the screen.

1. The typical power is measured with following transition from horizontal 2 scale pattern to vertical 2 scale pattern.
2. The deep sleep power is the consumed power when the panel controller is in deep sleep mode.
3. The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by Waveshare.
6.3 Panel AC Characteristics

6.3.1 MCU Interface Selection

MCU interface is pin selectable by BS1 shown in Table 6-1.

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>BS1</th>
<th>RES#</th>
<th>CS#</th>
<th>D/C#</th>
<th>SCL</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCU Interface</td>
<td>4-wire serial peripheral interface (SPI)</td>
<td>L</td>
<td>RES#</td>
<td>CS#</td>
<td>DC#</td>
<td>SCL</td>
</tr>
<tr>
<td></td>
<td>3-wire serial peripheral interface (SPI) – 9 bits SPI</td>
<td>H</td>
<td>RES#</td>
<td>CS#</td>
<td>L</td>
<td>SCL</td>
</tr>
</tbody>
</table>

Note: (1) L is connected to VSS and H is connected to VDDIO

6.3.2 MCU Serial Interface (4-wire SPI)

The 4-wire SPI consists of serial clock SCL, serial data SDA, D/C# and CS#.

The control pins status in 4-wire SPI in writing command/data is shown in Table 6-2 and the write procedure 4-wire SPI is shown in Table 6-2.

<table>
<thead>
<tr>
<th>Function</th>
<th>SCL pin</th>
<th>SDA pin</th>
<th>D/C# pin</th>
<th>CS# pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write command</td>
<td>↑</td>
<td>Command bit</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Write data</td>
<td>↑</td>
<td>Data bit</td>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

Note: (1) L is connected to VSS and H is connected to VDDIO

(2) ↑ stands for rising edge of signal

(3) SDA (Write Mode) is shifted into an 8-bit shift register on every rising edge of SCL in the order of D7, D6, ... D0. The level of D/C# should be kept over the whole byte. The data byte in the shift register is written to the Graphic Display Data RAM (RAM)/Data Byte register or command Byte register according to D/C# pin.

Figure 6-1: Write procedure in 4-wire SPI mode

In the read operation (Command 0x1B, 0x27, 0x2D, 0x2E, 0x2F, 0x35). After CS # is pulled low, the first byte sent is command byte, D/C# is pulled low. After command byte sent, the following byte(s) read are data byte(s), so D/C# bit is then pulled high. An 8-bit data will be shifted out on every clock falling edge. The serial data SDA bit shifting sequence is D7, D6, to D0 bit. Figure 6-2 shows the read procedure in 4-wire SPI.
6.3.3 MCU Serial Interface (3-wire SPI)

The 3-wire SPI consists of serial clock SCL, serial data SDA and CS#. The operation is similar to 4-wire SPI while D/C# pin is not used and it must be tied to LOW. The control pins status in 3-wire SPI is shown in Table 6-3.

In the write operation, a 9-bit data will be shifted into the shift register on every clock rising edge. The bit shifting sequence is D/C# bit, D7 bit, D6 bit to D0 bit. The first bit is D/C# bit which determines the following byte is command or data. When D/C# bit is 0, the following byte is command. When D/C# bit is 1, the following byte is data. Table 6-3 shows the write procedure in 3-wire SPI.

<table>
<thead>
<tr>
<th>Function</th>
<th>SCL pin</th>
<th>SDA pin</th>
<th>D/C# pin</th>
<th>CS# pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write command</td>
<td>↑</td>
<td>Command bit</td>
<td>Tie LOW</td>
<td>L</td>
</tr>
<tr>
<td>Write data</td>
<td>↑</td>
<td>Data bit</td>
<td>Tie LOW</td>
<td>L</td>
</tr>
</tbody>
</table>

Note: (1) L is connected to VSS and H is connected to VDDIO

(2) ↑ stands for rising edge of signal

In the read operation (Register 0x1B, 0x27, 0x2D, 0x2E, 0x2F, 0x35). SDA data are transferred in the unit of 9 bits. After CS# pull low, the first byte is command byte, the D/C# bit is as 0 and following with the register byte. After command byte send, the following byte(s) are data byte(s), with D/C# bit is 1. After D/C# bit sending from MCU, an 8-bit data will be shifted out on every clock falling edge. The serial data SDA bit shifting sequence is D7, D6, to D0 bit. Figure 6-4 shows the read procedure in 3-wire SPI.
6.3.4 Interface Timing

The following specifications apply for: VDDIO - VSS = 2.2V to 3.7V, CL=20pF

### Write mode

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_{SCL}</td>
<td>SCL frequency (Write Mode)</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>MHz</td>
</tr>
<tr>
<td>t_{CSSU}</td>
<td>Time CS# has to be low before the first rising edge of SCLK</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{CSSH}</td>
<td>Time CS# has to remain low after the last falling edge of SCLK</td>
<td>65</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{CSH}</td>
<td>Time CS# has to remain high between two transfers</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{GLUH}</td>
<td>Part of the clock period where SCL has to remain high</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{GLUL}</td>
<td>Part of the clock period where SCL has to remain low</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{SIH}</td>
<td>Time SI (SDA Write Mode) has to be stable before the next rising edge of SCL</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{SIHLD}</td>
<td>Time SI (SDA Write Mode) has to remain stable after the rising edge of SCL</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
</tbody>
</table>

### Read mode

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_{SCL}</td>
<td>SCL frequency (Read Mode)</td>
<td>-</td>
<td>-</td>
<td>2.5</td>
<td>MHz</td>
</tr>
<tr>
<td>t_{CSSU}</td>
<td>Time CS# has to be low before the first rising edge of SCLK</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{CSSH}</td>
<td>Time CS# has to remain low after the last falling edge of SCLK</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{CSH}</td>
<td>Time CS# has to remain high between two transfers</td>
<td>250</td>
<td>-</td>
<td>-</td>
<td>ns</td>
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<tr>
<td>t_{GLUH}</td>
<td>Part of the clock period where SCL has to remain high</td>
<td>180</td>
<td>-</td>
<td>-</td>
<td>ns</td>
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<tr>
<td>t_{GLUL}</td>
<td>Part of the clock period where SCL has to remain low</td>
<td>180</td>
<td>-</td>
<td>-</td>
<td>ns</td>
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<tr>
<td>t_{SOH}</td>
<td>Time SO (SDA Read Mode) will be stable before the next rising edge of SCL</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>ns</td>
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<tr>
<td>t_{SOHLD}</td>
<td>Time SO (SDA Read Mode) will remain stable after the falling edge of SCL</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>ns</td>
</tr>
</tbody>
</table>

Note: All timings are based on 20% to 80% of VDDIO-VSS
## 7. Command Table

<table>
<thead>
<tr>
<th>Command Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Command</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Gate setting</strong></td>
<td>A[8:0] = 127h [POR], 286 MUX MUX Gate lines setting as (A[8:0] + 1).</td>
</tr>
<tr>
<td><strong>B[2:0] = 000 [POR]</strong></td>
<td>Gate scanning sequence and direction</td>
</tr>
<tr>
<td><strong>B[2]: GD</strong></td>
<td>Selects the 1st output Gate GD = 0 [POR], G0 is the 1st gate output channel, gate output sequence is G0, G1, G2, G3, ... GD = 1, G1 is the 1st gate output channel, gate output sequence is G1, G0, G3, G2, ...</td>
</tr>
<tr>
<td><strong>B[1]: SM</strong></td>
<td>Change scanning order of gate driver. SM = 0 [POR], G0, G1, G2, G3...295 (left and right gate interlaced) SM = 1, G0, G2, G4 ...G294, G1, G3, ...G295</td>
</tr>
<tr>
<td><strong>B[0]: TB</strong></td>
<td>TB = 0 [POR], scan from G0 to G295 TB = 1, scan from G295 to G0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Gate Driving voltage Control</strong></th>
<th><strong>Set Gate driving voltage</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A[4:0] = 00h [POR]</strong></td>
<td><strong>VGH</strong> setting from 10V to 20V</td>
</tr>
<tr>
<td><strong>A[4:0]</strong></td>
<td><strong>VGH</strong></td>
</tr>
<tr>
<td>00h</td>
<td>20</td>
</tr>
<tr>
<td>03h</td>
<td>10</td>
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<tr>
<td>04h</td>
<td>10.5</td>
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<tr>
<td>05h</td>
<td>11</td>
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<tr>
<td>06h</td>
<td>11.5</td>
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<tr>
<td>07h</td>
<td>12</td>
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<tr>
<td>08h</td>
<td>12.5</td>
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<tr>
<td>09h</td>
<td>13</td>
</tr>
<tr>
<td>0Ah</td>
<td>13.5</td>
</tr>
<tr>
<td>0Bh</td>
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<tr>
<td>0Ch</td>
<td>14.5</td>
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</tbody>
</table>
## Command Table

<table>
<thead>
<tr>
<th>R/W</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Source Driving voltage Control</td>
<td>Set Source driving voltage when POR, VSH1 at 15V, VSH2 at 5V.</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>A7</td>
<td>A6</td>
<td>A5</td>
<td>A4</td>
<td>A3</td>
<td>A2</td>
<td>A1</td>
<td>A0</td>
<td>B[7:0] = A8h [POR], VSH2 at 5V.</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>B7</td>
<td>B6</td>
<td>B5</td>
<td>B4</td>
<td>B3</td>
<td>B2</td>
<td>B1</td>
<td>B0</td>
<td>C[7:0] = 32h [POR], VSL at -15V.</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>C7</td>
<td>C6</td>
<td>C5</td>
<td>C4</td>
<td>C3</td>
<td>C2</td>
<td>C1</td>
<td>C0</td>
<td>VSL setting from -5V to -17V.</td>
</tr>
</tbody>
</table>

### 2.7inch e-Paper

- **A[7]/B[7] = 1**, VSH1/VSH2 voltage setting from 2.4V to 8.8V
- **A[7]/B[7] = 0**, VSH1/VSH2 voltage setting from 9V to 17V
- **C[7] = 0**, VSL setting from -5V to -17V

#### Initial Code Setting

<table>
<thead>
<tr>
<th></th>
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<td>9.2</td>
<td>3Oh</td>
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<td>9.4</td>
<td>3Oh</td>
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<td>37h</td>
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<td>15</td>
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<td>4Ah</td>
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<td>4Bh</td>
<td>17</td>
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<tr>
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<td>13.8</td>
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#### Program Initial Code Setting

*The command required CLKEN = 1.*

Refer to Register 0x22 for detail. BUSY pad will output high during operation.

### Write Register for Initial Code Setting

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<tr>
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<td>11.8</td>
<td>4Ah</td>
<td>16.8</td>
</tr>
<tr>
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</tr>
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</table>
## Command Table

<table>
<thead>
<tr>
<th>R/W</th>
<th>D/C#</th>
<th>Hex</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>OC</td>
<td>0</td>
<td>0</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>Booster Soft start Control</td>
<td>Booster Enable with Phase 1, Phase 2 and Phase 3 for soft start current and duration setting. A[7:0] -&gt; Soft start setting for Phase 1 = 8[0]h [POR] B[7:0] -&gt; Soft start setting for Phase 2 = 9[0]h [POR] C[7:0] -&gt; Soft start setting for Phase 3 = 9[0]h [POR] D[7:0] -&gt; Duration setting = 0[0]h [POR]</td>
</tr>
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<td>1</td>
<td>A0</td>
<td>A0</td>
<td>A0</td>
<td>A0</td>
<td>A0</td>
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<td>A0</td>
<td>A0</td>
</tr>
<tr>
<td>0</td>
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<td>1</td>
<td>B0</td>
<td>B0</td>
<td>B0</td>
<td>B0</td>
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<td>D0</td>
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<td>D0</td>
<td>D0</td>
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</tbody>
</table>

### Bit Description of each byte:
- **A[5:4]** / **B[6:5]** / **C[6:5]**
- **Driving Strength Selection**
  - 000: 1 (Weakest)
  - 001: 2
  - 010: 3
  - 011: 4
  - 100: 5
  - 101: 6
  - 110: 7
  - 111: 8 (Strongest)

- **B[3:0]**
- **Min Off Time Setting of GOR** [Time unit]
  - 0000: NA
  - 0001: ~
  - 0010: 2.6
  - 0011: 3.2
  - 0100: 3.9
  - 0101: 4.6
  - 0110: 5.4
  - 1000: 6.3
  - 1001: 7.3
  - 1010: 8.4
  - 1011: 9.5
  - 1100: 11.5
  - 1101: 13.8
  - 1110: 16.3

- **D[5:0]**: duration setting of phase
- **D[5:4]**: duration setting of phase 3
- **D[3:2]**: duration setting of phase 2
- **D[1:0]**: duration setting of phase 1

- **Bit[1:0]**
- **Duration of Phase** [Approximation]
  - 00: 10ms
  - 01: 20ms
  - 10: 30ms
  - 11: 40ms

## Deep Sleep mode

- **A[1:0]**: Description
  - 00: Normal Mode [POR]
  - 01: Enter Deep Sleep Mode 1
  - 11: Enter Deep Sleep Mode 2

After this command initiated, the chip will enter Deep Sleep Mode, BUSY pad will keep output high.

Remark:
To Exit Deep Sleep mode, User required to send HWRESET to the driver.
<table>
<thead>
<tr>
<th>Command Table</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data Entry mode setting</td>
<td>Define data entry sequence</td>
</tr>
<tr>
<td></td>
<td>The setting of incrementing or decrementing of the address counter can be made independently in each upper and lower bit of the address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>00 – Y decrement, X decrement,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>01 – Y increment, X decrement,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 – Y increment, X decrement,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 – Y increment, X increment [POR]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A[2] = AM</td>
<td>Set the direction in which the address counter is updated automatically after data are written to the RAM.</td>
</tr>
<tr>
<td></td>
<td>AM = 0, the address counter is updated in the X direction. [POR]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AM = 1, the address counter is updated in the Y direction.</td>
<td></td>
</tr>
<tr>
<td>0 0 12 0 0 0 1 0 0 1 0 0</td>
<td>SW RESET</td>
<td>It resets the commands and parameters to their S/W Reset default values except R10h-Deep Sleep Mode</td>
</tr>
<tr>
<td></td>
<td>During operation, BUSY pad will output high.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note: RAM are unaffected by this command.</td>
<td></td>
</tr>
<tr>
<td>0 0 14 0 0 0 1 0 1 0 0</td>
<td>HV Ready Detection</td>
<td>HV ready detection</td>
</tr>
<tr>
<td></td>
<td>A[7:0] = 00h [POR]</td>
<td>The command required CLKEN=1 and ANALOGEN=1.</td>
</tr>
<tr>
<td></td>
<td>Refer to Register 0x22 for detail.</td>
<td>After this command initiated, HV Ready detection starts.</td>
</tr>
<tr>
<td></td>
<td>BUSY pad will output high during detection.</td>
<td>The detection result can be read from the Status Bit Read (Command 0x2F).</td>
</tr>
<tr>
<td></td>
<td>The detection result can be read from the Status Bit Read (Command 0x2F).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A[6:4]=n for cool down duration: 10ms x (n+1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A[2:0]=m for number of Cool Down Loop to detect.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The max HV ready duration is 10ms x (n+1) x (m)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HV ready detection will be trigger after each cool down time. The detection will be completed when HV is ready. For 1 shot HV ready detection, A[7:0] can be set as 00h.</td>
<td></td>
</tr>
<tr>
<td>Command Table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
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</tr>
<tr>
<td>**R/W#</td>
<td>D/C#</td>
<td>Hex</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| 0 | 0 | 15 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | VCI Detection | VCI Detection A[2:0] = 100 [POR], Detect level at 2.3V
A[2:0] : VCI level Detect
| | | | | | | | | | | | A[2:0] | VCI level |
| | | | | | | | | | | | 011 | 2.2V |
| | | | | | | | | | | | 100 | 2.3V |
| | | | | | | | | | | | 101 | 2.4V |
| | | | | | | | | | | | 110 | 2.5V |
| | | | | | | | | | | | 111 | 2.6V |
| | | | | | | | | | | | Other | NA |

The command required CLKEN=1 and ANALOGEN=1
Refer to Register 0x22 for detail.

After this command initiated, VCI detection starts.
BUSY pad will output high during detection.
The detection result can be read from the Status Bit Read (Command 0x2F).

| 0 | 0 | 18 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | Temperature Sensor Control | Temperature Sensor Selection A[7:0] = 48h [POR], external temperature sensor A[7:0] = 80h Internal temperature sensor |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |

Write to temperature register. A[7:0] = 7Fh [POR]

| 0 | 0 | 1A | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | Temperature Sensor Control (Write to temperature register) | |
| 0 | 1 | | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |

Read from temperature register.

| 0 | 0 | 1B | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | Temperature Sensor Control (Read from temperature register) | Write Command to External temperature sensor. A[7:6] = 00h [POR], B[7:0] = 00h [POR], C[7:0] = 00h [POR]. |
| 0 | 1 | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
| 0 | 1 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| 0 | 1 | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |

A[7:6] Select no of byte to be sent
00 Address + pointer
01 Address + pointer + 1st parameter + 2nd pointer
11 Address
A[5:0] – Pointer Setting
B[7:0] – 1st parameter
C[7:0] – 2nd parameter
The command required CLKEN=1.
Refer to Register 0x22 for detail.

After this command initiated, Write Command to external temperature sensor starts. BUSY pad will output high during operation.

| 0 | 0 | 1F | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | IC revision Read | Read IC revision [POR 0x0D] |
| 1 | 1 | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | | | |
## Command Table

<table>
<thead>
<tr>
<th>R/W</th>
<th>D/C#</th>
<th>Hex</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>20</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Master Activation</td>
<td>Activate Display Update Sequence&lt;br&gt;The Display Update Sequence Option is located at R22h.&lt;br&gt;BUSY pad will output high during operation. User should not interrupt this operation to avoid corruption of panel images.</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Display Update Control</td>
<td>RAM content option for Display Update&lt;br&gt;A[7:0] = 00h [POR]&lt;br&gt;B[7:0] = 00h [POR]&lt;br&gt;A[7:4] Red RAM option&lt;br&gt;0000 Normal&lt;br&gt;0100 Bypass RAM content as 0&lt;br&gt;1000 Inverse RAM content&lt;br&gt;A[3:0] BW RAM option&lt;br&gt;0000 Normal&lt;br&gt;0100 Bypass RAM content as 0&lt;br&gt;1000 Inverse RAM content&lt;br&gt;B[7] Source Output Mode&lt;br&gt;0 Available Source from S0 to S175&lt;br&gt;1 Available Source from S8 to S167</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Write RAM (Black White) / RAM 0x24</td>
<td>After this command, data entries will be written into the BW RAM until another command is written. Address pointers will advance accordingly&lt;br&gt;For Write pixel:&lt;br&gt;Content of Write RAM(BW) = 1&lt;br&gt;For Black pixel:&lt;br&gt;Content of Write RAM(BW) = 0</td>
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<tr>
<td>Command Table</td>
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<tr>
<td>Display Update</td>
<td>Display Update Sequence Option: Enable the stage for Master Activation [7:0] = FFh (POR).</td>
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<tr>
<td>Control 2</td>
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<table>
<thead>
<tr>
<th>Operating sequence</th>
<th>Parameter (in Hex)</th>
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<tbody>
<tr>
<td>Enable clock signal</td>
<td>00</td>
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<tr>
<td>Disable clock signal</td>
<td>01</td>
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<tr>
<td>Enable clock signal</td>
<td>Enable Analog</td>
</tr>
<tr>
<td>Disable clock signal</td>
<td>03</td>
</tr>
<tr>
<td>Enable clock signal</td>
<td>Load LUT with DISPLAY Mode 1</td>
</tr>
<tr>
<td>Disable clock signal</td>
<td>99</td>
</tr>
<tr>
<td>Enable clock signal</td>
<td>Load temperature value</td>
</tr>
<tr>
<td>Disable clock signal</td>
<td>B9</td>
</tr>
<tr>
<td>Enable clock signal</td>
<td>Enable Analog</td>
</tr>
<tr>
<td>Enable clock signal</td>
<td>Display with DISPLAY Mode 1</td>
</tr>
<tr>
<td>Disable clock signal</td>
<td>F7</td>
</tr>
<tr>
<td>Enable clock signal</td>
<td>Load temperature value</td>
</tr>
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<table>
<thead>
<tr>
<th>Command</th>
<th><strong>Write RAM (RED) / RAM 0x26</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 26 0 0 1 0 0 1 1 0</td>
<td>After this command, data entries will be written into the RED RAM until another command is written. Address pointers will advance accordingly.</td>
</tr>
<tr>
<td>For Red pixel:</td>
<td></td>
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<tr>
<td>Content of Write RAM(RED) = 1</td>
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<tr>
<td>For non-Red pixel [Black or White]:</td>
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</tr>
<tr>
<td>Content of Write RAM(RED) = 0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th><strong>Read RAM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 27 0 0 1 0 0 1 1 1</td>
<td>After this command, data read on the MCU bus will fetch data from RAM. According to parameter of Register 41h to select reading RAM0x24/ RAM0x26, until another command is written, Address pointers will advance accordingly.</td>
</tr>
<tr>
<td>The 1st byte of data read is dummy data.</td>
<td></td>
</tr>
</tbody>
</table>
## Command Table

<table>
<thead>
<tr>
<th>R/W#</th>
<th>DC/CE</th>
<th>Hex</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>VCOM Sense</td>
<td>Enter VCOM sensing conditions and hold for duration defined in 29h before reading VCOM value. The sensed VCOM voltage is stored in register. The command required CLKEN=1 and ANALOGEN=1. Refer to Register 0x22 for detail. BUSY pad will output high during operation.</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>29</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>VCOM Sense Duration</td>
<td>Stabilizing time between entering VCOM sensing mode and reading acquired. A[3:0] = 9h, duration = 10s. VCOM sense duration = (A[3:0]+1) sec</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>A3</td>
<td>A2</td>
<td>A1</td>
<td>A0</td>
<td>Program VCOM OTP</td>
<td>Program VCOM register into OTP. The command required CLKEN=1. Refer to Register 0x22 for detail. BUSY pad will output high during operation.</td>
</tr>
<tr>
<td>0</td>
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<td>2A</td>
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<td>1</td>
<td>0</td>
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<td>0</td>
<td>Write VCOM register</td>
<td>Write VCOM register from MCU interface A[7:0] = 00h [POR]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>00h</td>
<td>-0.2</td>
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<td>-1.7</td>
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<tr>
<td>04h</td>
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<td>-1.8</td>
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<tr>
<td>0Ah</td>
<td>-0.4</td>
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<td>-1.9</td>
</tr>
<tr>
<td>0Ch</td>
<td>-0.5</td>
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<td>-2.0</td>
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<tr>
<td>11h</td>
<td>-0.6</td>
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<td>-2.1</td>
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<tr>
<td>14h</td>
<td>-0.7</td>
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<td>-2.2</td>
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<tr>
<td>18h</td>
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<td>-2.4</td>
</tr>
<tr>
<td>20h</td>
<td>-1.0</td>
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<td>-2.5</td>
</tr>
<tr>
<td>24h</td>
<td>-1.1</td>
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<td>-2.6</td>
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<tr>
<td>28h</td>
<td>-1.2</td>
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<td>-2.7</td>
</tr>
<tr>
<td>2Ch</td>
<td>-1.3</td>
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<tr>
<td>30h</td>
<td>-1.4</td>
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<td>-2.9</td>
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<td>34h</td>
<td>-1.5</td>
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<td>-3.0</td>
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<tr>
<td>3Ch</td>
<td>-1.6</td>
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<tbody>
<tr>
<td>40h</td>
<td>-1.6</td>
<td>Other</td>
<td>NA</td>
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<tr>
<td>Command Table</td>
<td>R/W# D/C# Hex</td>
<td>D7 D6 D5 D4 D3 D2 D1 D0</td>
<td>Command</td>
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<tr>
<td>---------------</td>
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</tr>
<tr>
<td></td>
<td>0 0 2D</td>
<td>0 0 1 1 1 1 1 0</td>
<td>OTP Register Read for Display Option</td>
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<tr>
<td></td>
<td>1 1 A7 A6 A5 A4 A3 A2 A1 A0</td>
<td>1 1 A7 A6 A5 A4 A3 A2 A1 A0</td>
<td>User ID Read</td>
</tr>
<tr>
<td></td>
<td>1 1 0 0 A5 A4 0 0 A1 A0</td>
<td>0 0 2F</td>
<td>Program WS OTP</td>
</tr>
</tbody>
</table>
## Command Table

<table>
<thead>
<tr>
<th>R/W#</th>
<th>D/C#</th>
<th>Hex</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command</th>
<th>Description</th>
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<td>1</td>
<td>Load WS OTP</td>
<td>Load OTP of Waveform Setting</td>
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<td></td>
<td>The command required CLKEN=1. Refer to Register 0x22 for detail.</td>
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<td>BUSY pad will output high during operation.</td>
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<td>0</td>
<td>Write LUT register</td>
<td>Write LUT register from MCU interface [227 bytes], which contains the</td>
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<td></td>
<td>content of VS[nX-LUTm], TP[nX], RP[n], SR[nXY], FR and XO[nXY]</td>
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<td>Refer to Session 8.7 WAVEFORM SETTING</td>
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<td>For details, please refer to SSD1680A application note.</td>
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<td>BUSY pad will output high during operation.</td>
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<td>CRC Status Read</td>
<td>A[15:0] is the CRC readout value</td>
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<td></td>
<td>Program OTP Selection according to the OTP Selection Control [R37h and R38h]</td>
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<td>The command required CLKEN=1. Refer to Register 0x22 for detail.</td>
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<td>BUSY pad will output high during operation.</td>
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<td>Program OTP selection</td>
<td>Write Register for Display Option</td>
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<td>0: Default [POR]</td>
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<td>Write Register for Display</td>
<td>Display Mode for WS[7:0]</td>
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<td>Option</td>
<td>C[7:0] Display Mode for WS[15:8]</td>
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<td>D[7:0] Display Mode for WS[23:16]</td>
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<td>0: Display Mode 1</td>
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<td>1: Display Mode 2</td>
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<td>F[6]: Ping-Pong for Display Mode 2</td>
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<td>0: RAM Ping-Pong disable [POR]</td>
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<td>1: RAM Ping-Pong enable</td>
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<td></td>
<td></td>
<td>1) A[7:0]~J[7:0] can be stored in OTP</td>
</tr>
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<td></td>
<td>2) RAM Ping-Pong function is not support for Display Mode 1</td>
</tr>
<tr>
<td>Command Table</td>
<td></td>
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</tr>
<tr>
<td>R/W</td>
<td>D/C#</td>
<td>Hex</td>
<td>D7</td>
<td>D6</td>
<td>D5</td>
<td>D4</td>
<td>D3</td>
<td>D2</td>
<td>D1</td>
<td>D0</td>
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<td>38</td>
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<td>A7</td>
<td>A6</td>
<td>A5</td>
<td>A4</td>
<td>A3</td>
<td>A2</td>
<td>A1</td>
<td>A0</td>
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<td>1</td>
<td>B7</td>
<td>B6</td>
<td>B5</td>
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<td>B3</td>
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<td>B0</td>
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<tr>
<td>0</td>
<td>1</td>
<td>C7</td>
<td>C6</td>
<td>C5</td>
<td>C4</td>
<td>C3</td>
<td>C2</td>
<td>C1</td>
<td>C0</td>
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<tr>
<td>0</td>
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<td>D7</td>
<td>D6</td>
<td>D5</td>
<td>D4</td>
<td>D3</td>
<td>D2</td>
<td>D1</td>
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<td>E0</td>
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<tr>
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<td>1</td>
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<td>F6</td>
<td>F5</td>
<td>F4</td>
<td>F3</td>
<td>F2</td>
<td>F1</td>
<td>F0</td>
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<tr>
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<td>1</td>
<td>G7</td>
<td>G6</td>
<td>G5</td>
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<tr>
<td>0</td>
<td>1</td>
<td>H7</td>
<td>H6</td>
<td>H5</td>
<td>H4</td>
<td>H3</td>
<td>H2</td>
<td>H1</td>
<td>H0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>I7</td>
<td>I6</td>
<td>I5</td>
<td>I4</td>
<td>I3</td>
<td>I2</td>
<td>I1</td>
<td>I0</td>
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<tr>
<td>0</td>
<td>1</td>
<td>J7</td>
<td>J6</td>
<td>J5</td>
<td>J4</td>
<td>J3</td>
<td>J2</td>
<td>J1</td>
<td>J0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Command Description
- **Write Register for User ID**
  - **A[7-0]~J[7-0]: UserID [10 bytes]**
  - Remarks: A[7-0]~J[7-0] can be stored in OTP

### OTP program mode
- **A[1:0] = 00: Normal Mode [POR]**
- **A[1:0] = 11: Internal generated OTP programming voltage**
- User is required to EXACTLY follow the reference code sequences

### Border Waveform Control
- **A[7:6]: Select VBD option**
  - **A[5:4]: Fix Level Setting for VBD**
    - **A[5:4] = 00: VBD level**
  - **A[1:0]: GS Transition setting for VBD**
    - **VBD Level Selection:**
      - 00b: VCOM; 01b: VSH1;
      - 10b: VSL; 11b: VSH2
    - **A[1:0] = 00: LUT0**
    - **A[1:0] = 01: LUT1**
    - **A[1:0] = 10: LUT2**
    - **A[1:0] = 11: LUT3**

### End Option (EOPT)
- **Option for LUT end**
  - Data bytes should be set for this command or programmed into Waveform setting.
  - **22h: Normal.**
  - **07h: Source output level keep previous output before power off**
## Command Table

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 41 0 1 0 0 0 0 0 1 A0</td>
<td>Read RAM Option</td>
</tr>
<tr>
<td>0 1 0 0 0 0 0 0 0 0 0 0 0</td>
<td>A0: Read RAM corresponding to RAM0x24</td>
</tr>
<tr>
<td>1 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>A0: Read RAM corresponding to RAM0x26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 44 0 1 0 0 0 1 0 0 0 0 0 0 0 0</td>
<td>Set RAM X-address Start / End position</td>
</tr>
<tr>
<td>0 0 45 0 1 0 0 0 1 0 0 0 0 0 0 0 0</td>
<td>Set RAM Y-address Start / End position</td>
</tr>
<tr>
<td>0 0 46 0 1 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>Auto Write RED RAM for Regular Pattern</td>
</tr>
</tbody>
</table>

### Auto Write RED RAM for Regular Pattern

- **A[7]:** The 1st step value, POR = 0
- **A[6:4]:** Step Height, POR = 000
- **A[2:0]:** Step of alter RAM in Y-direction according to Gate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>8</td>
<td>100</td>
<td>128</td>
</tr>
<tr>
<td>001</td>
<td>16</td>
<td>101</td>
<td>256</td>
</tr>
<tr>
<td>010</td>
<td>32</td>
<td>110</td>
<td>296</td>
</tr>
<tr>
<td>011</td>
<td>64</td>
<td>111</td>
<td>NA</td>
</tr>
</tbody>
</table>

- **A[2:0]:** Step Width, POR = 000
- **A[2:0]:** Step of alter RAM in X-direction according to Source

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>000</td>
<td>8</td>
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</tr>
<tr>
<td>001</td>
<td>16</td>
<td>101</td>
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</tr>
<tr>
<td>010</td>
<td>32</td>
<td>110</td>
<td>NA</td>
</tr>
<tr>
<td>011</td>
<td>64</td>
<td>111</td>
<td>NA</td>
</tr>
</tbody>
</table>

BUSY pad will output high during operation.
## Command Table

<table>
<thead>
<tr>
<th>R/W#</th>
<th>D/C#</th>
<th>Hex</th>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
<th>Command Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>47</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Auto Write B/W RAM for Regular Pattern</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>A_7</td>
<td>A_6</td>
<td>A_5</td>
<td>A_4</td>
<td>A_3</td>
<td>A_2</td>
<td>A_1</td>
<td>A_0</td>
<td>Command A[7:0] = 00h [POR]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A[7]: The 1st step value, POR = 0</td>
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<tr>
<td></td>
<td></td>
<td>A[6:4]: Step Height, POR= 000</td>
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<td></td>
<td>Step of alter RAM in Y-direction according to Gate</td>
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<td></td>
<td>A[2:0]: Step Width, POR= 000</td>
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<tr>
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<td></td>
<td>Step of alter RAM in X-direction according to Source</td>
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<td>010</td>
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<td>32</td>
<td>110</td>
<td>NA</td>
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<td>011</td>
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<td>64</td>
<td>111</td>
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<td></td>
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</tr>
</tbody>
</table>

During operation, BUSY pad will output high.

| 0    | 0    | 4E  | 0  | 1  | 0  | 0  | 1  | 1  | 1  | 0  | Set RAM X address counter |
| 0    | 1    | A_7 | A_6 | A_5 | A_4 | A_3 | A_2 | A_1 | A_0 | Make initial settings for the RAM X address in the address counter (AC) A[5:0]: 00h [POR]. |

| 0    | 0    | 4F  | 0  | 1  | 0  | 0  | 1  | 1  | 1  | 1  | Set RAM Y address counter |
| 0    | 1    | A_7 | A_6 | A_5 | A_4 | A_3 | A_2 | A_1 | A_0 | Make initial settings for the RAM Y address in the address counter (AC) A[8:0]: 000h [POR]. |

| 0    | 0    | 7F  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | NOP |
| 0    | 1    | A_7 | A_6 | A_5 | A_4 | A_3 | A_2 | A_1 | A_0 | This command is an empty command; it does not have any effect on the display module. However it can be used to terminate Frame Memory Write or Read Commands. |
8. Optical Specifications

Measurements are made with that the illumination is under an angle of 45 degree, the detection is perpendicular unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>White Reflectivity</td>
<td>White</td>
<td>30</td>
<td>35</td>
<td></td>
<td>%</td>
<td>8-1</td>
</tr>
<tr>
<td>CR</td>
<td>Contrast Ratio</td>
<td>Indoor</td>
<td>8:1</td>
<td></td>
<td></td>
<td></td>
<td>8-2</td>
</tr>
<tr>
<td>GN</td>
<td>2Grey Level</td>
<td>-</td>
<td></td>
<td>DS+(WS-DS)*n(m-1)</td>
<td></td>
<td></td>
<td>8-3</td>
</tr>
<tr>
<td>T update</td>
<td>Image update time</td>
<td>at 25 °C</td>
<td></td>
<td>3</td>
<td></td>
<td>sec</td>
<td></td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td>Topr</td>
<td></td>
<td>1000000</td>
<td></td>
<td>times or 5years</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

8-1. Luminance meter: Eye-One Pro Spectrophotometer.

8-2. CR=Surface Reflectance with all white pixel/Surface Reflectance with all black pixels.

8-3 WS: White state, DS: Dark state
### 9. Handling, Safety and Environment Requirements

<table>
<thead>
<tr>
<th><strong>Warning</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the electrophoretic material. In case of contact with electrophoretic material, wash with water and soap.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Caution</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components. Disassembling the display module. Disassembling the display module can cause permanent damage and invalidates the warranty agreements. Observe general precautions that are common to handling delicate electronic components. The glass can break and front surfaces can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Data sheet status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product specification</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Limiting values</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Application information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Where application information is given, it is advisory and does not form part of the specification.</td>
</tr>
</tbody>
</table>
### 10. Reliability test

<table>
<thead>
<tr>
<th>NO</th>
<th>Test items</th>
<th>Test condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low-Temperature Storage</td>
<td>T = -25°C, 240 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test in white pattern</td>
</tr>
<tr>
<td>2</td>
<td>High-Temperature Storage</td>
<td>T = 70°C, RH = 40%, 240h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test in white pattern</td>
</tr>
<tr>
<td>3</td>
<td>High-Temperature Operation</td>
<td>T = 50°C, RH = 35%, 240h</td>
</tr>
<tr>
<td>4</td>
<td>Low-Temperature Operation</td>
<td>0°C, 240h</td>
</tr>
<tr>
<td>5</td>
<td>High-Temperature, High-Humidity Operation</td>
<td>T = 40°C, RH = 80%, 240h</td>
</tr>
<tr>
<td>6</td>
<td>High Temperature, High Humidity Storage</td>
<td>T = 50°C, RH = 80%, 240h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test in white pattern</td>
</tr>
<tr>
<td>7</td>
<td>Temperature Cycle</td>
<td>1 cycle: [-25°C 30 min] → [+70°C 30 min] : 50 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test in white pattern</td>
</tr>
<tr>
<td>8</td>
<td>UV exposure Resistance</td>
<td>765 W/m² for 168 hrs, 40°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test in white pattern</td>
</tr>
<tr>
<td>9</td>
<td>ESD Gun</td>
<td>Air+/15KV; Contact+/8KV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Test finished product shell, not display only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air+/8KV; Contact+/6KV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Naked EPD display, no including IC and FPC area)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air+/4KV; Contact+/2KV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Naked EPD display, including IC and FPC area)</td>
</tr>
</tbody>
</table>

**Note:**
Put in normal temperature for 1 hour after test finished, display performance is ok.
11. Block Diagram
12. Reference Circuit
14. Typical Operating Sequence

14.1 Normal Operation Flow

1. Power On
   - Supply VCI
   - Wait 10ms

2. Set Initial Configuration
   - Define SPI interface to communicate with MCU
   - HW Reset
   - SW Reset by Command 0x12
   - Wait 10ms

3. Send Initialization Code
   - Set gate driver output by Command 0x01
   - Set display RAM size by Command 0x11, 0x44, 0x45
   - Set panel border by Command 0x3C

4. Load Waveform LUT
   - Sense temperature by int/ext TS by Command 0x18
   - Load waveform LUT from OTP by Command 0x22, 0x20 or by MCU
   - Wait BUSY Low

5. Write Image and Drive Display Panel
   - Write image data in RAM by Command 0x4E, 0x4F, 0x24, 0x26
   - Set softstart setting by Command 0x0C
   - Drive display panel by Command 0x22, 0x20
   - Wait BUSY Low

6. Power Off
   - Deep sleep by Command 0x10
   - Power OFF
15. Inspection condition
15.1 Environment
Temperature: 25±3°C
Humidity: 55±10%RH

15.2 Illuminance
Brightness: 1200~1500LUX; distance: 20-30CM; Angle: Relate 30° surround.

15.3 Inspection method

15.4 Display area
### 15.5 Inspection standard

#### 15.5.1 Electric inspection standard

<table>
<thead>
<tr>
<th>NO.</th>
<th>Item</th>
<th>Standard</th>
<th>Defect level</th>
<th>Method</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Display</td>
<td>Display complete</td>
<td>MA</td>
<td>Visual inspection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Display uniform</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Black/White spots</td>
<td>D≤0.25mm, Allowed 0.25mm &lt; D ≤0.4mm, N ≤3, and Distance ≥5mm 0.4mm &lt; D Not Allow</td>
<td>MI</td>
<td>Visual/Inspection card</td>
<td>Zone A</td>
</tr>
<tr>
<td>3</td>
<td>Black/White spots (No switch)</td>
<td>L≤0.6mm, W≤0.2mm, N≤1 L≤2.0mm, W&gt;0.2mm Not Allow L&gt;0.6mm Not Allow</td>
<td>MI</td>
<td>Visual/Inspection card</td>
<td>Zone A</td>
</tr>
<tr>
<td>4</td>
<td>Ghost image</td>
<td>Allowed in switching process</td>
<td>MI</td>
<td>Visual inspection</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Flash spots/Larger FPL size</td>
<td>Flash spots in switching, Allowed FPL size larger than viewing area, Allowed</td>
<td>MI</td>
<td>Visual/Inspection card</td>
<td>Zone A</td>
</tr>
<tr>
<td>6</td>
<td>Display wrong/Missing</td>
<td>All appointed displays are showed correct</td>
<td>MA</td>
<td>Visual inspection</td>
<td>Zone A</td>
</tr>
<tr>
<td>7</td>
<td>Short circuit/Circuit break/Display abnormal</td>
<td>Not Allow</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 15.5.2 Appearance inspection standard

<table>
<thead>
<tr>
<th>NO.</th>
<th>Item</th>
<th>Standard</th>
<th>Defect level</th>
<th>Method</th>
<th>Scope</th>
</tr>
</thead>
</table>
| 1   | B/W spots / Bubble / Foreign bodies / Dents | ![Image of B/W spots](image)  
D ≤ 0.25 mm, Allowed  
0.25 mm < D ≤ 0.4 mm, N ≤ 3  
D > 0.4 mm, Not Allow | MI            | Visual inspection    | Zone A       |
| 2   | Glass crack                 | Not Allow                                                                | MA           | Visual / Microscope | Zone A  
Zone B       |
| 3   | Dirty                       | Allowed if can be removed                                                | MI           | Visual / Microscope | Zone A  
Zone B       |
| 4   | Chips/Scratch/ Edge crown   | ![Image of Chips/Scratch/ Edge crown](image)  
X ≤ 3 mm, Y ≤ 0.5 mm, And without affecting the electrode is permissible  
2 mm ≤ X or 2 mm ≤ Y, Not Allow  
W ≤ 0.1 mm, L ≤ 5 mm, No harm to the electrodes and N ≤ 2 allow | MI           | Visual / Microscope    | Zone A  
Zone B       |
| 5   | TFT Cracks                  | ![Image of TFT Cracks](image)                                             | MA           | Visual / Microscope | Zone A  
Zone B       |
| 6   | Dirty/ foreign body         | Allowed if can be removed/ allow                                           | MI           | Visual / Microscope | Zone A  
Zone B       |
| 7   | FPC broken/ Goldfingers oxidation/ scratch | ![Image of FPC broken/ Goldfingers oxidation/ scratch](image)  
Not Allow | MA           | Visual / Microscope    | Zone B       |
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Criteria</th>
<th>MI, V, Microscope, Ruler, Zone A, B</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>TFT edge bulge / TFT chromatic aberration</td>
<td>TFT edge bulge: X≤3mm, Y≤0.3mm, Allowed. TFT chromatic aberration: Allowed</td>
<td>MI, V, Microscope</td>
</tr>
<tr>
<td>9</td>
<td>PCB damaged/ Poor welding/ Curl</td>
<td>PCB (Circuit area) damaged Not Allow, PCB Poor welding Not Allow, PCB Curl≤1%</td>
<td>MI, V, Ruler</td>
</tr>
<tr>
<td>10</td>
<td>Edge glue height/ Edge glue bubble</td>
<td>Edge Adhesives H≤PS surface (Including protect film): Edge adhesives see p in≤1/2 Margin width. Length excluding Edge adhesives bubble: bubble Width ≤1/2 Margin width: Length &lt;0.5mm, n&lt;5</td>
<td>MI, V, Ruler</td>
</tr>
<tr>
<td>11</td>
<td>Protect film</td>
<td>Surface scratch but not effect protect function, Allowed</td>
<td>MI, V, Inspection</td>
</tr>
<tr>
<td>12</td>
<td>Silicon glue</td>
<td>Thickness ≤PS surface (With protect film): Fall cover the IC; Shape: The width on the FPC ≤0.5mm (Front) The width on the FPC≤1.0mm (Back) smooth surface, No obvious raised.</td>
<td>MI, V, Inspection</td>
</tr>
<tr>
<td>13</td>
<td>Warp degree (TFT substrate)</td>
<td>t≤2.0mm</td>
<td>MI, V, Ruler</td>
</tr>
<tr>
<td>14</td>
<td>Color difference in COM area (Silver point area)</td>
<td>Allowed</td>
<td>MI, V, Inspection</td>
</tr>
</tbody>
</table>
16. Packing

PACKLING ORDER:

1) Putting 15 pcs Modules on each PET tray. And cover a dedicated EPE film.

2) Putting 9 pcs PET trays together with 1 empty tray on the top of PET tray.

3) the tray together with rubber band

4) Insert in the ESD bag, add desiccant in the ESD bag. Putting in the inner small carton (TYPE:182)

5) Putting 5 small cartons into one out carton

6) Packing finished

Note: 15 pcs in a tray, 9 trays in a inner carton, 5 inner cartons in a out carton, so 15x(10-1)x5=675pcs/Outcarton

Dimension (Small carton): 385*325*87mm

Dimension (Out carton): 394*344*470mm
17. Precautions

(1) Do not apply pressure to the EPD panel in order to prevent damaging it.

(2) Do not connect or disconnect the interface connector while the EPD panel is in operation.

(3) Do not touch IC bonding area. It may scratch TFT lead or damage IC function.

(4) Please be mindful of moisture to avoid its penetration into the EPD panel, which may cause damage during operation.

(5) If the EPD Panel / Module is not refreshed every 24 hours, a phenomena known as “Ghosting” or “Image Sticking” may occur. It is recommended to refreshed the ESL / EPD Tag every 24 hours in use case. It is recommended that customer ships or stores the ESL / EPD Tag with a completely white image to avoid this issue.

(6) High temperature, high humidity, sunlight or fluorescent light may degrade the EPD panel’s performance. Please do not expose the unprotected EPD panel to high temperature, high humidity, sunlight, or fluorescent for long periods of time.